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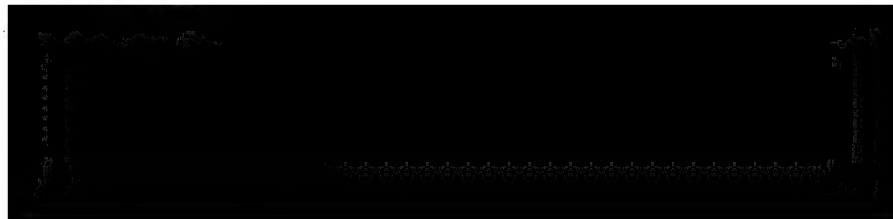
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SUPPLEMENT TO
SOVIET GEODETIC PHOTOGRAMMETRIC
INSTRUMENTATION

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INTRODUCTION

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25X1A5a1 The following report is submitted as a supplement to

"Soviet Geodetic and

Photogrammetric Instrumentation". This supplement is forwarded for the use of technical personnel in the fields of photogrammetry, geodesy, photography and, to a lesser degree, for technicians working in the field of map reproduction.

The report consists of lists of references where detailed, operational diagrams, photographs, optical systems, etc. of instruments used by the Soviets in the above-mentioned sciences may be found in Soviet scientific literature.

Seven, recent Soviet references were selected as being most significant for the purpose of this report. They are as follows:

- I. Mikhaylov, V. Ya., Fotografiya i Aerofotografiya (Photography and Aerial Photography), Izdatel'stvo Geodezicheskoy i Kartograficheskoy Literatury, Moskva, 1952..... 3
- II. Drobyshev, F.V., Fotogrammetricheskiye Pribory i Instrumentovedeniye. Moscow, 1951 21
- III. Volosov, D.S., Metody rascheta slozhnykh fotograficheskikh sistem. (The Rating Methods of Complicated Photographic Systems). OGIZ 1948 30
- IV. Tudorovskiy, A.I., Teoriya Opticheskikh Priborov, (The Theory of Optical Devices). Part II (Part I was checked but did not contain desired instrumental information). Izdatel'stvo Akademii Nauk SSSR. Moskva, Leningrad, 1952 36

- V. Katalog - Spravochnik Laboratornykh Priborov i
Oborudovaniya. Vypusk 34. Mashgiz, 1949 43
- VI. 20th Anniversary of Soviet Geodesy and Cartography,
1919-1939. (Dvadtsat' Let Sovetskoy Geodezii i
Kartografii, 1919-1939.) 50
- VII. Shershen', A.I., Aerofotos"yenka, Letnos"yemochnyy
Protsess (Aerial Photography, Aerial-Surveying Process).
Izdatel'stvo Geodezicheskoy i Kartograficheskoy
Literatury, Moskva, 1949 52

Subject: Pictures of Photographic and Photogrammetric Instruments and Designs and Graphs of Operational Characteristics of Main Optical Systems, as Abstracted from Soviet Sources.

Source I: Mikhaylov, V. Ya., Fotografiya i Aerofotografiya (Photography and Aerial Photography), Izdatel'stvo Geodezicheskoy i Kartograficheskoy Literatury, Moskva, 1952.

Reference to Text Description	Figure or Table No.	Page on Which Fig. or Table is Found	Information Available
Page 35, Section 8	Fig. 10-e	Page 21	Detail Drawing of the "Ortogoz" Objective. Camera, "Fotokor" is equipped with this objective; it is an uncemented four-lens anastigmat. Data: Focal Length: 13.5 cm. Relative Aperture: 1:4.5 Field of View: 55°
Pages 35-36	Fig. 10-d	Page 21	Detail Drawing of the "Industar" Objective (of which there are several). This is an unsymmetrical semi-cemented anastigmatic objective. It is manufactured in various focal lengths.
Page 36	-	-	"Industar - 11" Objective (No picture). Used in reproduction cameras. These objectives are manufactured with focal lengths: 21, 30, 63, 90, and 120 cm. Relative Apertures: 1:4.5 for small cameras 1:9 for large cameras

Reference to Text Description	Figure or Table No.	Page on which Fig. or Table is Found	Information Available
Page 36	-	-	<p>"Industar-22" Objective. (No picture).</p> <p>Data: Focal Length: 50 mm.</p> <p>Relative Aperture: 1:3.5</p> <p>Field of View: 46°</p> <p>Resolving Power, in Center of Field: 40 lines;</p> <p>Resolving Power, at Edge: 20 lines.</p> <p>Used in cameras, "FED" and "Zorkiy".</p>
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Page 37	Fig. 21	Page 36	<p>Detail Drawings of External View and Diagrams of Internal Arrangement of Lenses of "Yupiter" Objectives for "Kiyev" Photo-apparatus. (Camera)</p>
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Reference to Text Description	Figure or Table No.	Page on which Fig. or Table is Found	Information Available
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Reference to Text Description	Figure or Table No.	Page on which Fig. or Table is Found	Information Available
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Page 38	Fig. 22-g.	Page 37	Reproduction ("Reproduktсионnyy") Objec- tive. This objective "has the same char- acteristics as the Universal Objective, but the objective's mounting is made in the form of two pipes, moving one in the other, which makes it possible to move the objective rather far out from the light sensitive coating and make an exposure from a distance of 15 cm., increasing by this means the scale of the representation up to 1:2, which it is not possible to do with the ordinary "FED" objective."

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-	Fig. 23-a	Page 38	"Russar-19" Objective.
-	Fig. 23-b	Page 38	"Russar-25" Objective.
-	Fig. 23-v	Page 38	"Russar-29" Objective.
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Page 38	Fig. 25-g	Page 39	Worm-screw ("Chervyachnaya") Mount. Used in those cases where the focusing is done by moving the objective along the optical axis.
Page 49	Fig. 40	Page 49	<p>Pictures (External View) of the "AFA-33" Series of ("Aerofotoapparat") Aerial-Photo-Apparatuses = Cameras and Attachments. These apparatuses are "with cones for objectives with various focal lengths. In the case of very short-focus apparatuses the cone is lacking. The objectives have a between-the-lens shutter, the threshold speed of which rarely exceeds 1:120 sec. Curtain-slot shutters for apparatuses, intended for precision operations, are used rarely, in view of the distortions produced by them."</p> <p>The apparatuses of this series shown in Fig. 40 include the following: "AFA-33/100," "AFA-33/75," "AFA-33/50," "AFA-33/20."</p> <p>The labelled parts indicated are as follows: 1. camera section; 2. cone; 3. cassette; 4. electric power unit; 5. control</p>

Reference to Test Description	Figure or Table No.	Page on which Fig. or Table is Found	Information Available
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Page 87	Fig. 60	Page 87	Detail Drawing: A Developing Device (Not named).
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Source II. Drobyshev, F.V.: Fotogrammetricheskiye Pribory i Instrumentovedeniye. Moscow, 1951

Section 3: Optical Systems in Photogrammetric Devices

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203	132	Detail Drawing of Formation of Distorted Cuts on a Photograph at Its Slopes in Connection with an Immovable Sighting Ray.
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		Section 33: Design of Stereoplanigraph APB and S-4.
220	149	Detail Drawing of Spatial Intersection which Has the Form of a Triangle with a Parallelogram.
221	150	Design of Stereoplanigraphs SPB and S-4.
		Section 34: Structure of Mechanical and Optical Parts of Stereoplanigraphs
223	151	Picture: Stereoplanigraph SPB (External View).
224	152	Detail Drawing: Cardan Construction of Nuts of Lead Screws of Stereoplanigraph.
225	153	Drawing: Reinforcing of Cameras of Stereoplanigraph.
226	154	Drawing: Auxiliary Optical System of SPB.
227	155	Drawing: Structure of Mechanism of Auxiliary Optical System SPB (Labelled Parts).
228	156	Drawing: Observation System ((Including Objectives, Lenses, Prisms, etc.) of Stereoplanigraph SPB. (Labelled Parts).)
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240	160	Drawing of Intersection with the Unaided Eye.
241	161	Drawing of Intersection in Stereoscopic Drawing Device RP-6.
243	162	<u>Picture: Stereoscopic Drawing Device RP-6. (Labelled Parts).</u>

Source III. Volosov, D.S., Metody rascheta slozhnykh fotograficheskikh sistem.
(The Rating Methods of Complicated Photographic Systems). OGIZ 1948.

Chapter 2: Method of Classing Coefficients of Aberration of the Third Order
in Symmetrical and Quasi-symmetrical Photographic Systems which
Contain Components of Finite Thickness.

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| 31 | 1 | DRAWINGS of Optical Anastigmats (Objectives). |
| | 1-a | Ross's "Ekspress". |
| | 1-b | Audol'f's "Planar". |
| | 1-c | M. Rusinov's "Russar". |

(Note: All of these systems are combinations, consisting of two "halves", separated by air space, in which the aperture diaphragm is located).

Paragraph 1: Two Possible Cases of "Completing" Symmetrical Systems.

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| 33 | 3 | Derivation of a System in the Case where $\begin{array}{c} \longrightarrow 2 \\ 1 \longleftarrow X \end{array}$. |
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Paragraph 2: Synthesis of a Symmetrical System in the Case $\begin{array}{c} \longrightarrow 2 \\ 1 \longleftarrow X \end{array}$.

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| 35 | 3 | Combination X Applied as the Second Half of a Complex System. |
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Paragraph 3: Synthesis of a Symmetrical System in the Case $\begin{array}{c} \longrightarrow 2 \\ 1 \longleftarrow X \end{array}$.

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| 41 | 4 | Combination X Applied as the First Half of a Complex System. |
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Paragraph 4: Quasi-symmetrical Systems.

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| 47 | 5 | Optical Design of a Quasi-symmetrical Anastigmat (Objective). |
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Chapter 3. Two-Component Plane-astigmats as Elements of Complex Systems.

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| 51 | 6 | Optical Design of the Anastigmat (Objective). "Kino-Plazmat". |
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		Paragraph 1: Two Types of Plane-anastigmats (Objectives)
52	7	Combination of Type X _A
52	8	Combination of Type X _B
		Paragraph 4: Computation Investigations (Note: Figures 9-11 Computation Graphs)
69	12	Optical Design of 4-Lens Objective "Ortagoz".
69	13	Optical Design of Three-Lens Objective with Compensator for Astigmatism and Curved Field.
		(Note: Figures 14-15: Graphs of Computation Curves for Optical Systems).
		Chapter 4. Analysis of Several Present-Day Types of Complex Anastigmatic Objectives.
		Paragraph 3. Light-Powerful (of great light-gathering power) of the "Planar" type.
92	16	Optical Design of Several Anastigmats (Anastigmatic Objectives) Variation of "Planar".
92	16 a	Drawings showing Optical Design of a variation of the "Planar" anastigmatic Objective shown in Figure 1-b of this text. The variation consists of two-lens cemented components in place of the outer lens shown in figure 1-b. It is said that the possibilities of variations (field of possible re- solings) of systems of the type of Fig. 16-a are extremely varied.
	16 b	Drawing of optical Design of Merté System (a Variation of the "Planar" Anastigmat)
	16 c ("v")	Drawing showing Optical Design of Another Variation of the "Planar" Anastigmatic Objective.

<u>Page</u>	<u>Figure</u>	
164	24e	Drawing of Volosov Objective, a five-lens anastigmatic objective. "Sometime later (in 1937 - 1938) the author of these lines also undertook an investigation of this rather unusual design of Taylor, at the same time trying to simplify it, in particular, investigating the resolving for a five-lens design of an anastigmat".
166	25	Optical Design of the "Montar" Objective (German System). (Omitting here the exposition of the results obtained (extremely interesting), we shall point out only that a comparative and fuller evaluation of them (anastigmats) will be possible only later, when the construction of the foreign long-focus complex anastigmats will have become known and, in particular, the German Systems of the type "Zonar" and "Montar" (Fig. 17-a and 25) and the American systems of the type "Aero-Ektar" (Fig. 38)."
183	26a 26b	Diagrams of "Dispersion, Formed by Rays of Oblique Pencils..." etc.
187	27	"Graph of Aberration of Broad Pencils of Rays."
		Part 2: Method of Computing Photographic Systems with Variable Optical Characteristics
189	28	Drawing: Warmisham System. (Pr. pat. specif. 398, 807). Paragraph 1. The Area Paraxial Optics.
196 230	29 31	Diagrams: Geometrical Interpretation of Junctions; etc.
234	32	Drawing: Optical Design of System of "Idar." (Objective)

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234	33	Diagrams of Computations.
268	36	
269	37	Drawing: Design of Achromatic Wide-Angle System of the Type "Hypergon" Containing Lanthanum Glasses.
282	40	Diagrams of Computations
306	46	
307	47	Drawing: Optical Design of Tele-objective "Telekon" (a K. Zeiss objective) Technical data.
309	48	Drawing: Optical Design of System of "Telefotoanastigmat" Objective.
314	49	Diagram of Computation.
327	50	Drawing: Optical Design of a Two-lens Objective with an anastigmatic Compensator.
331	51	Diagram of Computations.
348	56	
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363		Introduction.
364	57	Drawing: Mirror-Lens Double Meniscus System. (Worked out by D. S. Volosov in the beginning of 1942).
		Paragraph 1. The Meniscus Compensator.
365	58	Drawing: Design of the Meniscus Compensator.
		Paragraph 2. The "Meniscus Compensator - Spherical Mirror" System.
373	59	Drawing: Design of the "Meniscus Compensator Spherical Mirror System."
377	60	Graph of Dependence of Coefficient K on the Relative Aperture of the Meniscus System.

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		Paragraph 4. The "Two-lens Afocal Compensator - Spherical Mirror" System.
386	61	Drawing: Design of the "Two-lens Afocal Compensator - Spherical Mirror System.
389	62	Drawing: The Two-mirror System with Afocal Compensator.
		Paragraph 5. Elimination of "Lighting of the Image" (Parasitic lighting) in Mirror - Lens Photographic System.
390	63	Drawing: A Meniscus Tele-objective. (Showing a second possible solution to the problem of eliminating "parasitic" lighting (Absence of direct falling of the rays onto the photographic film)). Recommended by D. D. Maksutov by means of a supplementary reproducing System (D in Figure 63)
391	64	Drawing: Mirror-lens System with Finite Diaphragm.

Source IV. Tudorovskiy, A.I., Teoriya Opticheskikh Priborov, (The Theory of Optical Devices). Part II (Part I was checked but did not contain desired instrumental information). Izdatel'stvo Akademii Nauk SSSR. Moskva, Leningrad, 1952. DLC: QC 355.T832 (P 694, MF #278-A).

Chapter 16. The Photographic Objective

<u>Page</u>	<u>Figure</u>	<u>Information Available</u>
106	305	Drawing: Design of "Tessar" Type Objective with Focal Length - 174.74 and Relative Aperture 1:4.5.
133	320	Picture of "Universal Device" (for testing objectives and with special attachments for application of the J. Hartmann Method) of the "Askaniya" Firm.
173	331	Picture: Four Interferograms of "Tvayman" Obtained With a "Tessar" Objective (Focal Length = 210 mm., Relative Aperture 1:4.5).
Section 228. Survey of the Main Types of Photographic Objectives.		
177	332	Drawing: Design of the "Petsval" Objective. Built in 1840 using Petsval's computations. The first "powerful in light-gathering" objective. Data: $f/3.5$, $2\theta = 20-30^\circ$.
177	333	Drawing: Design of Symmetrical Objective of A. Shteyngeyl' (1865). Consists of 2 meniscuses with a diaphragm between them.
177	334	Drawing: Design of "Hypergon" Objective. This is a wide-angle objective manufactured by the firm of Hertz ("Gerts"). The designer, in 1900, was "Gyëyeg." (This is said to be "the first orthoscopic wide-angle objective").
178	335	Drawing: Design of "Aplanat" Objective. This represents "a perfectly natural transition from the symmetrical design

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| <u>Page</u> | <u>Figure</u> | <p>type which could not be corrected for astigmatism. The double objective has a relative aperture of 1:5.8 and a field of view of about 60° with full aperture. This objective enjoyed great popularity and retained its significance until recently (up to the time when the Hertz firm shut down); "in the first decade of the 20th Century, it was manufactured in Russia, in Warsaw, by the 'Fos' firm, which had received the right to produce it under another name: 'Planastigmat Fos'".</p> |
| 180 | 339 | <p>Drawing: Design of a Double Anastigmat, Composed of Two Un-identical "Protar" Lenses. (As for the "Protar" - "there exist a large number of symmetrical anastigmats, consisting of two halves, of which each is cemented out of more than three lenses").</p> |
| 181 | 340 | <p>Drawing: Design of the "Planar" of K. Zeiss, computed in 1896 by Rudol'f, which may be considered as the first representative of the second group of symmetrical uncemented anastigmats.</p> |
| 181 | 341 | <p>Drawing: Design of the "Tselor" Objective of the Hertz Firm, worked out by Gyëyeg in 1898. This is said to be a simpler design of the symmetrical anastigmats and that type are said to be very great in number.</p> |
| Section 229. | | <p>Objectives with a Large Field of View.
(<u>Wide-angle Objectives</u>).</p> |
| <p>(Note: See also the "Hypergon", Fig. 324 on Page 177).</p> | | |
| 183 | 342 | <p>Drawing. Design of the Zeiss "Topogon". This is a development and perfection of the orthoscopic wide-angle objective.</p> |

- | <u>Page</u> | <u>Figure</u> | |
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| | | This objective has the following characteristics: $f/6.3$, $2\beta = 90^\circ$, Focal Length: 150 mm. |
| 183 | 343 | Drawing: Design of "Liar-6" Wide-angle Objective, an M. M. Rusinov Objective. Data: Focal Length 100 mm., $f/5.4$ and $2\beta = 104^\circ$. |
| 183 | 344 | Drawing: Design of "Russar-25" (a M. M. Rusinov Objective). Characteristics: Focal Length 100 mm., $f/6.3$, $2\beta = 110^\circ$. |
| 183 | 345 | Drawing: Design of "Express" of Ross (a Wide-angle Objective, which, in Addition to "Ortometar" of Merté (K. Zeiss) of Almost Identical Construction, Has a Significant (Rather High) Light Gathering Power and a Good Correction of Distortion. Data: $f/4.5$, $2\beta = 70^\circ$. |

(Note: On page 183, it is stated: "There are a small group of wide-angle objectives in which distortion not only is not corrected, but, on the contrary, occurs up to very great values with the aim of significantly diminishing the angle between the main rays and the axis after their emergence from the center of the outlet pupil in comparison with those same angles in space of objects".).

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| 183 | 346 | Drawing: Design of the Hill ("Gill") Objective. Data $f/22$, $2\beta = 180^\circ$. |
| 184 | 347 | Drawing: Design of the Schulz ("Shul'ts") Objective. Data: Focal Length 35 mm., $f/5.6$, $2\beta = 135^\circ$. |
| 184 | 348 | Drawing: Design of the "Pleon" Objective. Data: Focal Length 72.5 mm., $f/8$, $2\beta = 130^\circ$. (Six lenses and plane-parallel plate of colored glass). |

Section 230. "Powerful in Light-gathering" ("Svetosil'nyye") Objectives.

Note: The first of these objectives was the very old "Petsval" objective. See Figure 332, page 177 of this volume.

Page Figure

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| 185 | 349 | Drawing: Design of the "Biotar" Objective. "In 1911 Rohr increased the relative aperture of the "Petsval" Objective to $f/2$ by the addition of a negative lens, placed almost in the focal plane in front of the light-sensitive coating, as can be seen from the design of the objective in Figure 349; this objective, called "Biotar", had no practical value; its 2β did not exceed 20° ". |
| 185 | 350 | Drawing: Design of the "Ernostar" Objective. "In 1924 the Erneman firm produced the "Ernostar" Objective, computed by Bertele with $f/1.3$, of relatively complex design, as can be seen in Figure 350; 2β = about $35-40^\circ$. The objective occupied a well-known place on the market: the "Ermanoks" camera with this objective for night exposures was produced by the firm of "Zeiss-Ikon." |
| 185 | 351 | Drawing: Design of the G. G. Slyusarev Objective. "In 1922 such an objective was computed by G. G. Slyusarev; one experimental model was prepared with a good result. Objectives which were very close to this design were produced in Europe and America some time later under the name "Takhar". In 1932 the objective of G. G. Slyusarev, which preserved the type, was perfected, while its 2β was brought to $45-50^\circ$; the design of this objective is given in Figure 351". |
| 185 | 352 | Drawing: Design of the "Kinoplasmat" of Rudol'f. "The symmetrical designs were adapted for computation of the "powerful in light-gathering" objectives by various firms. Thus, |

Page Figure

- for example, "Kinoplasmat" of Rudol'f, of the Hugo Mayer Firm has a design, represented in Figure 352; Data: $f/2$."
- 185 353 Drawing. Design of "Biotar" Objective. "In 1927 the K. Zeiss Firm produced a "powerful in light-gathering" objective under the former name "Biotar", computed by Merte, with $f/1.4$ and small 2β - not more than 30° . As can be seen in Figure 353, the design of this objective is very complex."
- 186 354 Drawing: Design of one of the Variants of the Compound Anastigmat "Uran" Type (D. S. Volosov). Data: Focal Length - from 25-500 mm., $f/2$ to $f/3.5$ and 2β from $40-63^\circ$.
- 186 355 Drawing: Design of the "Aeroektar" Objective of the "Kodak" Firm. Data: Focal Length 175 mm., Relative Aperture $f/2.5$ and $2\beta = 50^\circ$.
- 186 356 Drawing: Design of a Variant of "Ektar" Objective of "Kodak" Firm. Data: $f/1.5$.
- 186 357 Drawing: Design of the "Zonnar" Type Objective of the K. Zeiss-Ikon Firm. Data: Focal Length 50 mm., $f/1.5$ and $2\beta 46^\circ$. Note: These are made also with $f/1.4$ to $f/2$ and $f/2.8$.
- 187 358 Drawing: Design of a "Mirror-Lens Objective, Computed by D. S. Volosov, D. Yu. Gal'pern and Sh. Ya. Pechatnikova." Data: $f/1.4$, $2\beta = 15^\circ$.
- 187 359 Drawing: Design of One of the "New Mirror-Lens Objectives Considered in an Article by J. Flügge...of the Bush Firm" Designer: "Veydert"). Data: Nominal $f/0.9$, Equivalent (Effective) Aperture $f/1:1.15$ and $2\beta =$ about 34° .

Section 231. Teleobjectives.

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- 188 361 Drawing: "Design of Teleobjective of Bush 'Bistellar'." Data: $f/7$, 2β = about 300° , Focal Distance 1:2.
- 188 362 Drawing: "Design of the 'Magnar' Objective of the K. Zeiss Firm." Data: $f/10$, 2β = not above 150° , Focal Distance 1:4.
- 189 363 Drawing: "Design of the 'Teletessar' of the Zeiss Firm." Data: $f/6.3$, 2β = about $35-400^\circ$.
- 189 364 Drawing: "Design of the 'Telekon' Teleobjective of the K. Zeiss Firm." Data: $f/6.3$, Focal Length 1:2.44, Distortion does not exceed 0.2%, and 2β reaches 300° .
- 189 365 Drawing: "Design of Long-focus Teleobjective of the Bausch and Lomb Firm." Data: Focal Length = 1000 mm., $f/8$.
- 189 366 Drawing: "Design of Long-focus Teleobjective of the Bausch and Lomb Firm." Data: Focal Length = 1000 mm., $f/5.6$.

Section 233. Objectives for Aerial Photography

Note: There are no "pictures" or "diagrams" or "drawings" of objectives in this section but the following statement is made:

- 193 "Of the objectives mentioned earlier the following are used for geodetic operations: 'Tessar' with focal length = 250 mm. and $f/4.5$; 'Dagor' ($f' = 150$, $f/6.8$, 2β about 680°); 'Ortometar' ($f' = 135$, $f/4.5$, 2β up to 700°); Ross 'Ekspress' ($f' = 150$ and 200 mm., $f/4$, 2β up to 800°). The use of wide-angle objectives for geodetic purposes provides great economic savings (profits), since it makes possible decreasing the number of pictures necessary to obtain a map of a given section of a locality; therefore, for this purpose the following are used: 'Metrogon', very near to the 'Topogon',

and the wide-angle objectives of M.M. Rusinov of the 'Russar' Typ

Source V. Katalog - Spravochnik Laboratornykh Priborov i Oborudovaniya.
Vypusk 34. Mashgiz, 1949

Geodezicheskiye i Fotogrammetricheskiye Pribory.

Pages

- 5-8 Stereoplanigraph ("Stereoplanigraf"). Manufacturer: Armaments Ministry of USSR Plant ("Zavod Ministerstva Vooruzheniya SSSR") Text: Pages 5-8.
- 5 "Stereoplanigraf" - Picture of Apparatus.
- 6 "Stereoplanigraf" - Lateral View, Labelled Parts.
- 7 "Stereoplanigraf" - Detail Drawing of Working Parts.
- 7 "Stereoplanigraf" - Detail Drawing of Prisms, Numbered.
- 8 "Stereoplanigraf" - Technical Data.
- 9-10 Large Photo-rectifier FTB. Manufacturer: Armaments Ministry of USSR Plant. (Bol'shoy Fototransformator FTB)
- 9 Picture of above.
- 10 Technical Data.
- 11-13 Stereocomparator SK 18 x 18. Manufacturer: Armaments Ministry of USSR Plant. (Stereokomparator SK 18 x 18)
- 11 Picture of External View, Labelled Parts.
- 12 Detail Drawing of Working Parts.
- 13 Technical Data.
- 14-17 Precision Stereometer SM -3. Manufacturer: Armaments Ministry of USSR Plant. (Pretsizionnyy Stereometr SM - 3).
- 14 Picture of External View, Labelled Parts.
- 15 Detail Picture, Labelled Parts.
- 17 Technical Data.

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- 18-21 Drobyshev's Stereopantometer SPD -1. ("Stereopantometr SPD -1 Drobysheva")
- 18 Picture: External View.
- 19 Detail Drawing of Working Parts, Labelled Parts.
- 20 Detail Drawing, Labelled Parts.
- 21 Technical Data. Manufacturer: Plant of Main Administration of Geodesy and Cartography under the Council of Ministers of the USSR.
- 22-24 Konshin's Stereoscopic Drawing Device RP - 5. (Stereoskopicheskiy Risoval'nyy Pribor RP - 5 Konshina). Manufacturer: Plant of Main Administration of Geodesy and Cartography.
- 22 Picture: External View.
- 23 Picture: (Head of View), Labelled Parts.
- 24 Technical Data.
- 25-28 Drobyshev's Topographic Stereometer STD -1. ("Topograficheskiy Stereometr STD - 1 Drobysheva"). Manufacturer: Plant of Main Administration of Geodesy and Cartography.
- 29 Picture: External View with Labelled Parts.
- 30 Technical Data.
- 31-32 Russar - 29. Aerial Photo Objective with ZV -1 Shutter. ("Aerofotoob'yektiv Russar - 29 s Zatvorom ZV-1")
- 31 Picture: External View.
- 31 Picture: Internal View with Labelled Parts.
- 32 Technical Data. Manufacturer: Laboratory of Main Administration of Geodesy and Cartography.
- 33-36 Multiplex Aeroprojector. ("Aeroprojektor Multiplex"). Manufacturer: Laboratory of Main Administration of Geodesy and Cartography.

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- 33 Picture: External View.
- 34 Picture: "Stupped" View Showing Labelled Parts.
- 34 Detail Picture showing Labelled Parts.
- 35 Detail Drawing and Picture showing Labelled Parts.
- 36 Technical Data.
- 37-38 Astronomic Universal 5" ("Astronomicheskiy Universal 5"). Manufacturer: Plant of Main Administration of Geodesy and Cartography.
- 37 Picture.
- 38 Technical Data.
- 39-40 Optical Theodolite, Medium, "OTS". ("Opticheskiy Teodolit Sredniy OTS") Manufacturer: Plant of Ministry of Armaments of the USSR.
- 39 Picture.
- 40 Technical Data.
- 41-42 Optical Theodolite Small "OTM". ("Opticheskiy Teodolit Malyy OTM") Manufacturer: Plant of Ministry of Armaments of the USSR.
- 41 Picture.
- 42 Technical Data.
- 43-45 Optical Theodolite "OT-10". ("Opticheskiy Teodolit OT-10").
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Source VI. 20th Anniversary of Soviet Geodesy and Cartography, 1919-1939.
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Source VII: Shershen', A.I., Aerofotos"venka, Letnos"yemochnyy Protsess (Aerial Photography, Aerial-Surveying Process), Izdatel'stvo Geodezicheskoy i Kartograficheskoy Literatury, Moskva, 1949.

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23	13	<p>Picture. External View of So-called "Nine-Objective Aerial Camera 'AD-1' and 'AD-2'" ("Devyatib"yektivnyy Aerofotoapparat"). Designed by F. V. Drobyshev in 1932. The optical axes of the eight lateral lenses of this camera form 45° angles with the optical axis of the central lens. The objectives used are of Soviet manufacture with a focal length of 135 mm. and a negative size of 12 x 12 cm. The over-all angle of view of the outfit along the length and width of the course reached 140°. The distance between the aerial surveying routes with 40% overlapping exceeded the flight altitude by two times. After rectifying the oblique photographs into the projection of the plane one the over-all photograph of one exposure assumes the form of an octagon with the sides of a square inscribed in it equal to 50 cm. (See figures 14 and 14a). The camera is loaded with aerial film for 150 exposures. The winding of it and the setting into motion of the central shutters were accomplished by hand, by means of two hand wheels. The over-all weight of the camera was about 55 kg.</p>

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26	15	Picture. External View of So-called "Wide-Angle Adapter for Aerial-Camera FMK C-3" ("Shirokopolosnaya Nasadka k Aerofotoapparatu FMK C-3").	
27	16	Drawing Showing the Working Parts of the "Wide-Angle Adapter", the External View of Which is Shown in Fig. 15. In 1932, the Leningrad Scientific-Research Institute of Aerial Surveying (Leningradskiy Nauchno-issledovatel'skiy Institut Aeros"yemki) worked out an original optical attachment for a single-objective aerial camera, which made it possible to do plane-oblique photography without changing the position of the optical axis of the camera. This attachment, called by its designer Yu. K. Yutsevich "a wide-angle adapter", was placed in front of the objective of the usual camera and increased the field of view along the course up to 122°. A similar wide-angle adapter for aerial-camera FMK C-3 and its working principle are shown in figures 15 and 16."	
31	22	Picture. External View of Aerial Camera ("Aerofotoapparat") "AFA-13".	
"The first Soviet automatic aerial-camera 'AFA-13', manufactured by the 'Geodeziya' plant, was equipped with a new high-quality aerial photography objective with the brand name 'Industar-13' with a focal length of 300 mm			

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		<p>and a relative aperture of $f/4.5$. 'AFA-13' (Fig. 22) was activated by an electric motor operating on direct current with a voltage of 12 volts. The cassette contained 150 negatives 18 x 18 cm. in size. The film was aligned by means of the creation of a vacuum by a special suction device. The apparatus was equipped with a between-the-lens shutter of the Jalousie type, with exposure speeds of from 1/75 to 1/200 sec. and was operated by means of an intervalometer with a diapason of intervals between exposures of from 5 to 60 sec. A signal light for verifying the action of the mechanism of the cassette and a counter of the number of aerial photographs made lightened the work. A second counter was included in the camera and its indications were shown on each picture. The aerial mount of the Cardan type had rubber shock absorbers. 'AFA-13' was intended for plane surveying for purposes of military reconnaissance. It replaced the 'Potte' apparatus which had formerly been used for that purpose."</p>
33	23	<p>Picture. External View of Aerial Camera (and Attachments) ("Aerofotoapparat") "MAFA-13".</p> <p>"Later the AFA-13 was modernized. It was equipped with a short-focus objective 'Iussar-1', with a corresponding</p>

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		<p>alteration of the camera section. Other changes were also introduced into its design: the Jalousie shutter was replaced with a central shutter GOMZ, a liquid statoscope (of the D.I. Mendelejev type) was used, the readings of which were indicated on each photo; the winding of the aerial film was improved by means of a supplementary negative system, etc. This apparatus under the name 'MAFA-13' (Fig. 23) was used in such a form in aerial (flying) survey work until additional improvements were made. At length the focal plane was moved out of the cassette into the camera and the GOMZ shutter was replaced by a central shutter of the 'EV-1' type, designed by the Soviet engineer Vertiporokh."</p>
71	43	<p>Drawing. Working Parts of a Two-Slit camera (Aerial Camera) of the "AShchMAFA-2" Type.</p> <p>This type of two-slit camera is said to have "an important advantage over the one-slit apparatus. It makes it possible to photograph at the same time in two scales: in the larger scale -- with objective O_1 of the 'Plazmat' type, with $k = 210$ mm ($1:n = 1:3.5$, $2 = 600$), through slit z_1, and in a smaller scale -- with a wide-angle objective O_2 of the 'Russar-2' type, through slit z_2."</p> <p>Use of aerial film of a width of 25 cm.</p>

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135 71	Picture. External View of Range Finder "OPB-IM". Field of View of the order of 30°.
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137 74	Drawing. Detail Drawing Showing Gauges and Scales of the Supporting Installation for the Range Finder "OPE-IM".